The illustrations are also unusually good in both books, but while Wernicke's is professedly a mathematical treatise, the work of Buff leans more to the physical aspects of mechanics. There is, however, considerable reference to mathematics in Buff, in fact, he makes free use of the calculus when necessary.

The book consists of thirteen sections :—Section I. is on Rest and Motion ; Section II. on Movement in Space and Time : this contains, in addition to the usual theorems on the motion of a point, a useful article on harmonic motion. Section III. introduces the Composition of Movements ; in this will be found a discussion of experiments upon the trajectory of the bullet from the needle-gun. Section V. commences the subject of Mechanical Work ; we are glad to see in this book the principle of work receives that prominence which it unquestionably deserves. Section VII., on Friction, discusses, among other subjects, Pambour's experiments upon the friction of railway carriages. Section IX., upon the Efficiency of Machines, is admirable, the theory being properly proportioned to the experiments. We find here a full discussion of the subject, without that deluge of formulæ which is so often repulsive to those in search of distinct physical conceptions. Section X. contains what is familiar to us by the term Mechanism ; Section XII. is the most complete account of Centrifugal Force which we have met with in any work ; we have here a physical explanation of the permanent axes, of precession and nutation, of the mode of finding the masses of the heavenly bodies, and of various other matters. Section XIII., upon the Motion of the Pendulum, is a collection of interesting subjects, among them Foucault's pendulum, and a far better account of Cavendish's experiments than is to be found in any English book on mechanics. We are also a little surprised to find the weighing scales treated in this section. The arrangement is novel, and though doubtless much might be said in favour of it, yet we think, on the whole, it is not convenient.

We cordially recommend Buff's treatise to the notice of teachers of natural philosophy.

Mr. Wormell's book, which appears to have been specially intended for the London University examination for B.A. and B.Sc., contains practical and experimental illustrations, in addition to the usual matter. We should gladly welcome a thoroughly good work on the general plan which has been adopted by Mr. Wormell, but the book before us ought to receive careful revision before it is placed in the hands of students. We shall indicate some of the points that we have noticed which require correction. We do so in the belief that a future edition of the work might be made really valuable, and supply a much felt want. Some of the errors are common to this work and other text-books. We can, therefore, only accuse Mr. Wormell of reproducing them, but we cannot allow this excuse on every occasion.

On page 14, we find as follows :—"Any two forces F', F' applied at a point M may be transferred parallel to themselves to any other point M' in the line of direction of the resultant."

This proposition, if true, would assert that the attractions of the earth and sun upon the moon might be transferred to any heavenly body in space which happened to be in the line of direction of the resultant of the forces. The geometrical proof of the composition of parallel forces (p. 33) is meaningless, until the proposition referred to has been properly stated. This blunder is extremely common, it arises from enunciating as a property of forces what is really the definition of a rigid body.

On page 112 we find the following passage :—

"1. When the materials composing the surfaces in contact remain the same, the friction varies as the pressure. Suppose, for example, that a block of wood, having a hole bored in it, rests on a plane inclined at the angle of repose, if lead be poured in the hole, *the screw may be turned so as to incline the plane at a greater angle without causing the body to slide*. By increasing the pressure we increase the friction."

This is very bad ; the statement we have italicised in the second paragraph is entirely erroneous. So serious an error would be quite inexcusable even in one of those for whose use the book has been written.

We should have liked to have seen more experiments upon the mechanical powers cited. A student who reads (p. 94) that in the three sheave pulley-block the power is one-sixth of the load, will naturally be surprised when he finds by trial that the power must be one-fourth of the load ; nor can we find a single word in the book which would enlighten his difficulty. We should also have expected that the author would have replaced the antiquated and useless pulley systems which only exist in manuals, by some compact and useful machines like the differential pulley.

Such are some of the points which we consider to require careful revision before Mr. Wormell's book can be pronounced suitable for the use of students.

OUR BOOK SHELF

Contributions to Botany, Iconographic and Descriptive. By John Miers, F.R.S., F.L.S. Vol. 3, containing a complete Monograph of the Menispermaceæ. Sixty-six litho plates. (London : Williams and Norgate, 1864—1871.)

MR. MIERS'S long-promised Monograph of the Menispermaceæ forms the third volume of his valuable "Contributions to Botany." The intimate acquaintance of this veteran botanist with South American plants, and his long study of this particular family, extending over more than twenty years, render his observations peculiarly valuable to all systematic botanists. Although in some important particulars Mr. Miers combats the views of such high authorities as the authors of the "Flora Indica," and those of the "Genera Plantarum," he adduces reasons for his dissent, which will, at least, need careful consideration from all who hereafter write on these plants. Mr. Miers retains, with some modifications, his views of the structure of the different organs in this order published in the Annals of Natural History in 1851, and classifies the genera which constitute it into seven tribes, on characters dependent mainly on the structure of the fruit, and on the position of the cotyledons relatively to the radicle, whether incumbent or accumbent. The establishment of sixty-four distinct genera in the order, instead of the thirty-one admitted by Bentham and Hooker, may be open to criticism, but several of them contain only single species now for the first time described, which appear to be altogether aberrant types of the order. Good plates are always valuable ; and we have here sixty-six, drawn on stone by the author himself, containing careful dissections to illustrate the salient characters of the genera and more important species. This concluding volume of Mr.

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Miers's "Contributions to Botany" is no less valuable than any of its predecessors as a record of laborious and conscientious devotion to science. A. W. B.

An Elementary Treatise on Statics. By J. W. Mulcaster F.R.A.S., Military Tutor. (London: Taylor and Francis.)

THIS is a good book without any of that attempt at cramming, too common now in our elementary text-books. It is calculated to give the reader a good grasp of the elements of Statics. It goes over the usual ground, states and proves the principles well and clearly, and contains in each chapter a numerous and excellent series of examples. These examples consist of "graduated and classified groups of problems, each involving distinct statical principles." These, the author says, he finds, and our experience entirely agrees with his, make "an impression on the student's mind otherwise not attainable with problems indiscriminately taken." We gather from the book that it is the production of a good and practical teacher. J. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Aurora Borealis of Nov. 9 and 10

As the magnificent display of Aurora on the evening of the 10th was witnessed here under very favourable circumstances, and as several of its phases were of unusual occurrence, an abridged account may not be uninteresting.

The Northern Lights were first noticed at about 7.30 G.M.T., the appearance being that of a pale white light, which gradually rose from the N.N.W., until it completely enveloped the Great Bear, but was not sufficiently strong to hide even the faint star near Mizar. Towards 8.40 the auroral mist assumed the more definite form of three broad white bands, stretching across the sky from E. to W., the uppermost band lying just below Vega and Pollux.

At the same time a bank of dense black cloud rose from the N. horizon to the height of η Ursæ, and shot forth dark streamers as far as the upper arch of light. The streamers E. and W. were brighter than the central part, and waves of light moved slowly and at regular intervals from these brighter parts of the horizon, mingling together at the centre of the arch.

At 9.10 a very bright streamer made its appearance.

Up to this time the display had been colourless, but at 9.20 it assumed a greyish tinge, and had extended by 9.25 as far as β Cassiopeiæ.

At 9.30 the western extremity of the arch was of a bright red colour, whilst only a slight appearance of redness was visible in the E.

The aurora then became wonderfully brilliant, and the rapidity of the changes surpassed anything that had been seen here for years. Flashes of light were succeeded by waves, and these in their turn by small detached clouds, which travelled rapidly across the sky. At 9.45 the waves and streamers seemed to converge to a point slightly S.E. of β Andromedæ.

In the square of Pegasus a curiously-formed cloud, in the shape of an enormous bird, suddenly appeared and disappeared several times, sending forth each time streams of light E. and W., as if from its outstretched wings.

At 10 the auroral light was strongest, and then the waves, moving rapidly from the N., appeared to return for a short distance on their path when they had passed a few degrees S. of the zenith, like waves breaking on the sea shore.

At 10.30 two distinct arches of light, the upper one passing through β Andromedæ, the lower one near Polaris, intersected each other E. and W. at an altitude of about 20°.

At 10.40 all colour had disappeared in the west, but a very brilliant red streamer stretched from the E. nearly to the Twins. About this time a thick cloud of elliptic shape was formed between the points N.W. by N. and W. Beneath this cloud was a pale auroral glare, and from its upper side a mass of broad dark streamers rose towards Polaris. At the E. end of the cloud a very broad streamer moved gradually westward, and shortly afterwards a similar streamer formed near the W. and moved in the same direction.

At 10.45 α Arietis was the centre, towards which the new violet-coloured streamers and the waves and flashes tended.

The last-mentioned cloud was then replaced by another similar in form, but situated farther from the E., its outer streamers of a yellowish green colour meeting in Cassiopeia.

At 11 the only colour visible was the violet in the W.

At 11.5 a point S. of γ Pegasi was the centre of motion.

At 11.15 the dark streamers were sharply defined, but extended only a few degrees above the cloud. Ten minutes later the stars below Vega and Ursa minor were completely hidden, and then from 11.25 to 12.15 the aurora gradually died away, leaving only a faint white glare on the N.W. horizon. S. J. PERRY

Stonyhurst College Observatory

ON Friday evening, Nov. 10, I was fortunate enough to witness a brilliant display of the Aurora Borealis, which, if it did not surpass, certainly rivalled, that of Oct. 24, 1870.

At 9h. 20m. G.M.T. the whole sky was literally covered with auroral streaks to within 30° of the southern horizon, all apparently converging to a point near α Andromedæ. The streaks were of a white colour, having a slightly blueish tint (probably caused by the mass of intervening air), and their form, to within 15° of the point of convergence, was perfectly straight. The radial point was shown by an irregular mass of auroral light, from which bright streaks were spread out in every direction, those to the south being much shorter than the streaks to the north or west. The appearance of the sky at the time was that of the outstretched wing of an enormous bird. At 9h. 22m. a rich crimson glare was visible in the S.W., dividing the constellations Pegasus and Cygnus, and at 9h. 25m. a resplendent beam of white light 2° in width was conspicuous in the N.E.; its length was about 50°, and it was nearly parallel in direction with a line joining the stars α Capella and β Aurigæ, but 3° to the left of them. It remained visible for 5m.

At 9h. 25m. 30s. a white luminous meteor (apparently one of the "Leonides") shot swiftly across the constellation Pisces, having a brightness = Sirius, duration 0·5sec., and length of path 10°, left no train or sparks.

At 9h. 32m. the constellation Perseus was overspread by a luminous glare of a reddish colour (known to dyers by the appellation of "ruddy brown,") and which did not disappear for about 10m. At 9h. 34m. the crimson glow reappeared in the S.W. between Cygnus and Pegasus, thereby completing a gorgeous arch about 15° in width, extending from the S.W. to the N.E. horizon, passing over the constellations Cygnus, Lacerta, Perseus, Auriga, and Orion. This crimson belt divided the sky into two halves, that on the north being full of auroral streaks, two columns of which were very conspicuous in the north, passing over Ursa Major and extending nearly to the zenith. A small dark cloud lying horizontally across them divided them into two parts, each of which was distinctly visible.

At 9h. 40m. the streaks had entirely disappeared, being replaced by a diffused auroral glare, similar in appearance to the sky before dawn; but at 10h. the streamers reappeared with equal brilliancy. The radial point had now moved to 2° below β Andromedæ, and was now clearly pointed out by an irregular curve, or hook, about 4° or 5° in diameter, which, although observed at different times during the evening, was never completely formed, as 90° or 120° were always wanting to form a complete circle.

At 10h. 23m. a curious phenomenon presented itself. A small irregular patch of crimson light, about twice the diameter of the moon, appeared over β Triangulii, which slowly and gradually expanded, but after a lapse of about 30s. (when about 15° in diameter), its colour changed to the ordinary bluish white of the aurora, the phenomenon lasting altogether about 2m. At 10h. 25m. a broad *greenish* white band appeared in the N.E.

By this time the centre of convergence had reached β Triangulii, thus showing apparent progressive motion towards the *east* at the rate of about 15° per hour (which is the rate of the rotation of the earth upon its axis). It is worthy of notice that in the auroral displays of October 1870 the same stars formed the radiant, and its motion was in the same direction.

At 10h. 37m. a beautiful crimson beam appeared in Auriga (in the same position previously occupied by the white streak at 9h 35m.) Its length was about 40°, and at 10h. 50m. a gorgeous *triple* streak was visible in the same position, which presented the appearance of a broad crimson ribbon, with a border of *white* on each side. In about five minutes it faded out of sight.

At 11 o'clock the auroral light was again diffused over the whole northern sky, bounded on the south by a bright milky

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